

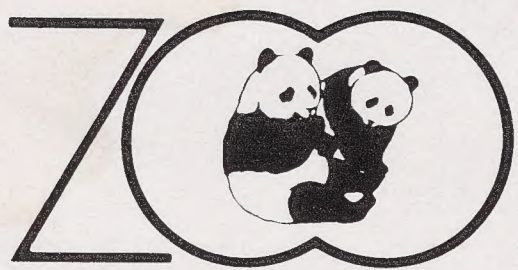
ZOOGOER

May-June 1987



**Primate
Fathers
(p. 4)**

**Friends
of the
National**



is a nonprofit organization of individuals, families, and organizations who are interested in helping to maintain the status of the National Zoological Park as one of the world's great zoos, to foster its use for education, research, and recreation, to increase and improve its facilities and collections, and to advance the welfare of its animals.

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**CONSTRUCTION
AND CHANGE**



Dear FONZ Member,

This spring, a considerable amount of construction is underway at the Zoo and this has led to some inconvenience and disruption. But it will soon be over and things will be so much better. The completion of Olmsted Walk, Phase II, will greatly beautify the Connecticut Avenue pedestrian entrance to the Zoo. The area will be planted with numerous trees, shrubs and flowering plants that should make visitors feel immediately relaxed upon entering the Zoo. We lost one tree to the improvements but will gain dozens of new ones.

The first phase of Olmsted Walk, from the Great Ape House down to the lower, east end of the Zoo near the Lion-Tiger Exhibit, was completed in 1986. However, the extensive landscaping plans for that area have been delayed due to budget cuts. We hope to use donations to substitute for the missing dollars. One way or another we intend to beautify that area with massive plantings.

In the coming months we will continue to expand our animal collection. The new Invertebrate Exhibit has opened (see p. 9); camels should return soon; the beaver exhibit has been renovated; and we expect that the completion of the new gibbon exhibit will allow these beautiful primates to show off their glorious gymnastic abilities for the first time. This fall a special display will open in the Invertebrate Exhibit. This will give visitors a chance to see the remarkable Japanese giant spider crabs. They are the largest of the crustaceans and are seldom seen outside Japan. When full grown, their long legs can span nine feet. The crabs and the exhibit are being donated by All Nippon Airways.

Visitors to the Forest Carnivore section may notice an unobtrusive but significant change. Through innovative and truly ingenious changes in exhibit design and animal management, there has been an enormous increase in animal activity there. An example of this is the coati exhibit. The cage floor has been transformed into an exploratorium for coatis, primarily diggers and nosers, so one can see animals on view for the greater part of each day. My staff are using their skills to fulfill my ambition of having a zoo full of exciting and beautiful animals doing interesting and stimulating things. My thanks to them all!

Sincerely,

Dr. Michael Robinson, Director
National Zoological Park

NEW AT THE ZOO: A new exhibit featuring fish of the Mississippi River Basin will open in the former polar bear area in June. Offering a fish-eye view of gar, sturgeon, large-mouth bass, golden shiners, and aquatic plant life, the exhibit will highlight the unusual paddlefish. Appropriately named, this fish boasts a nose in the shape of a canoe paddle which constitutes about one-third the length of its two- to three-foot body. The temporary exhibit will probably be open through 1989 while con-

struction of a tropical forest exhibit is underway in the surrounding area.

Also new this summer, a unique exhibit featuring a free-ranging family group of golden lion tamarins will bring a bit of Brazil to the Beaver Valley treetops from mid-May through early autumn. During a similar release last summer, scientists studied the animals' adjustment to the "wild;" this year researchers will spend several weeks collecting data on the tamarins' metabolism.



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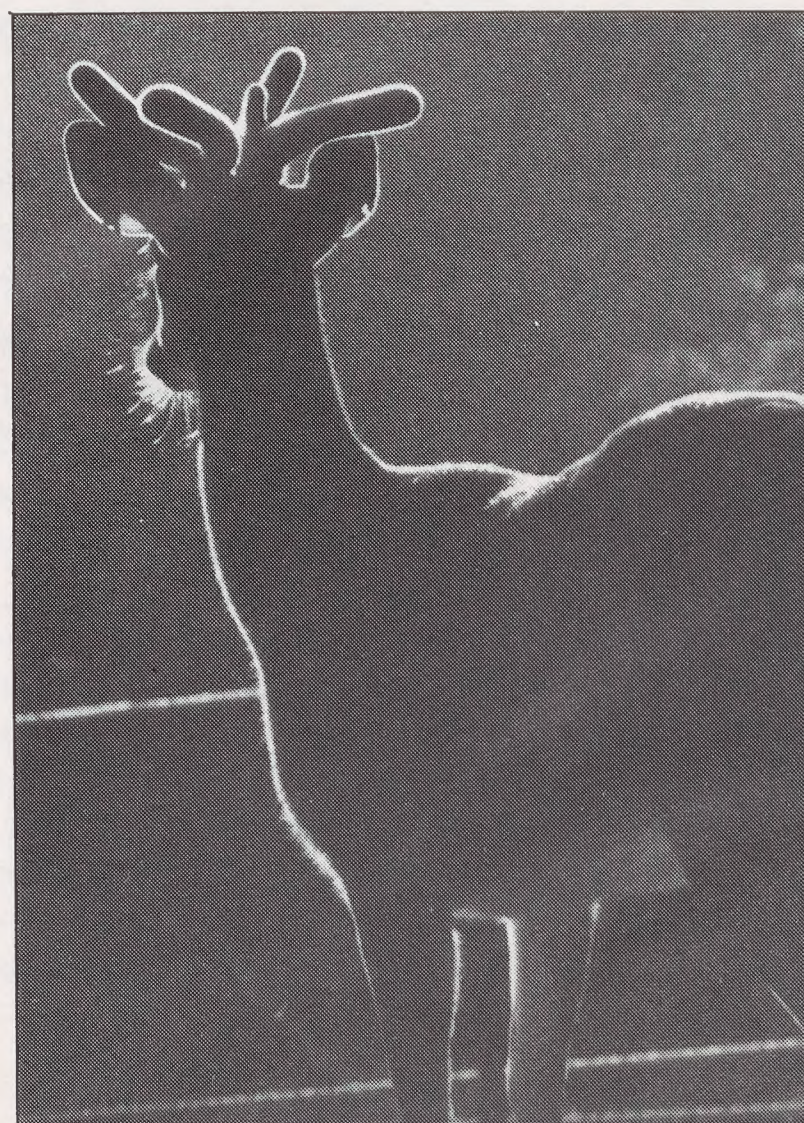
Cover: A male Goeldi's marmoset at the National Zoo. Marmoset and tamarin fathers share in caring for their young, setting an example for the family's older offspring (see "Primate Fathers," page 4). Photo by Jessie Cohen, NZP Graphics.



Bali mynah (p. 17)



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Primate Fathers

Austin L. Hughes

Photos by Jessie Cohen, NZP Graphics

Among humans of most cultures, a strong bond between fathers and their children is accepted as a normal part of life. But in the rest of the animal kingdom, paternal care of the young is the exception rather than the rule. In a few fish and amphibian species, males may guard eggs and young. Male birds often share in the tasks of incubation and feeding of nestlings, though generally to a lesser extent than females. But paternal care is much rarer among mammals than among birds. In most mammal species, the male's role in reproduction is confined to mating; by the time the young are born, a typical female mammal is on her own.

How then did paternal care evolve in humans? For answers, zoologists and comparative psychologists have looked at our closest animal relatives, the other primates. They discovered a bewildering array of parenting styles, ranging from typical mammalian indifference to near-human father-infant bonding. Such a wide range of paternal behaviors within a single order of mammals is unusual and is one reason why primates are a good starting place for an investigation of parent-offspring interactions.

Most primates live in social groups, where adult males often take the lead in defending the group against predators. This type of group defense is most dramatic in ground-dwelling Old World monkeys such as the baboons and macaques. In these species, adult males are much larger than females and have bigger canine teeth. For example, at 70 pounds, the weight of the average adult male baboon is more than double that of his female

counterpart; his canine teeth are more than two inches long, while the female's measure less than half an inch.

When a predator such as a cheetah, hyena, or leopard approaches a baboon troop in open country, adult males flee more slowly than do females and young, thus providing a kind of rear guard for the fleeing troop. If push comes to shove, male baboons will attack predators much larger than themselves. In Africa, leopards have been found badly, even mortally wounded after scrapes with male baboons.

Group defense can be considered a kind of indirect paternal behavior as it benefits the infants and juveniles in a monkey troop. Since a dominant male is likely to have sired at least some young infants in the troop, he often defends his own offspring when he takes the lead in a confrontation with a predator. Still, a male may engage in group defense even if he has no direct contact with any of the troop's infants and no way of knowing which infants are actually his own offspring.

In some other groups, such as marmosets and tamarins, fathers play a much more direct role in parenting. The tiny South American monkeys of the family *Callitrichidae* live high in tropical rainforests, where a lush growth of epiphytes (plants growing on other plants) supports a diverse community of insects and other invertebrates. The marmosets and tamarins live out their lives in this abundant tree-top world, rarely if ever coming to the ground. In this habitat, infant-carrying is one of the most important parental duties, since infants can never be put down until they are able to climb on their own. A large share of the carrying duty is taken by the father.

Marmosets and tamarins usually live in small social groups. Only one female in the group breeds, and she mates mostly or exclusively with one dominant male. There is some evidence that the menstrual cycles of

subordinate females are suppressed, so that they cannot become pregnant. Subordinate group members are sometimes grown offspring of the dominant pair, but some groups include adults unrelated to the breeding pair. In species for which good data are available, all adults in the group have been observed taking turns carrying infants, although the mother and father carry the infants most often.

In some other New World primates, the father's parental role is even more highly developed. In the *Orabassu titi* monkey, the typical social group consists of a mated pair and one or two young of different ages. While the most recently born continues to nurse, the weaned older sibling is able to climb through the trees on its own. Lacking other adults to help, an *Orabassu titi* father accepts the lion's share of the babysitting duty.

According to primatologists Sally Mendoza and William Mason, the father takes over most of the carrying within a few weeks of the birth. How soon he does so depends on the couple's previous experience. In pairs which have reared two or more previous young, the male carries the infant 92% of the time during the first two weeks of life. In less experienced pairs, the male carries the infant only 36% of the time during the first two weeks. But by the fifth week, even inexperienced fathers have assumed over 80% of the carrying duty.

The tropical forests of Southeast Asia are home to the gibbons, another group of primates in which fathers often carry their young. The gibbons are apes which swing through the trees holding onto the branches with their hands. An adult gibbon can make leaps of over 30 feet from one branch to another.

This method of locomotion, called brachiation, can be dangerous. An anatomist who studied a large number of skeletons of adult gibbons in museums found that an amazing 33% showed evidence of healed bone frac-

Dr. Hughes, the first editor of the Zoo-Goer, is now a visiting assistant professor of biology at the University of Iowa. He is the author of numerous scientific papers on the behavior of insects, fishes, birds, rodents, and primates and of a book on the evolution of kinship systems to be published next year by Oxford University Press.



Father's Day came to the Zoo in April this year, with the birth of offspring sired by orangutan "Junior" (below) and colobus monkey "Ditto" (right). Above, a youngster hitches a ride with "Pillsbury," Monkey Island's breeding male Barbary macaque.



Human fatherhood may be a relatively recent evolutionary development.

tures. If a gibbon makes a mistake about how much weight a branch can support, it is a long way down to the forest floor. Yet fractures are much less frequent among infant gibbons than among adults. Clinging to its parent's fur, an infant often emerges unscathed when the parent falls.

Gibbon infants cling on very tightly. Slung across the mother's abdomen, the infant grasps one side of her body with its hands and the other with its feet. The hair on the sides of an adult gibbon's torso and back is unusually long—as long as the infant's hand is wide. The infant not only grasps the hair but wraps it between and around its fingers to gain a better grip. In the first four months of its life, the infant gibbon never lets go of the mother's fur with all four limbs at the same time. In at least some of the gibbons, the father eventually takes over most caregiving. In the siamang gibbon, the mother carries the infant for the first 12 to 16 months. The father then takes over until the young siamang becomes independent during its third year.

While brachiation is unique to gibbons, it is interesting to note that this Old World group has some traits in common with the New World primates in which paternal care is highly developed. First, these primates tend to be monogamous, living either as isolated pairs or in small social groups in which only one pair is involved in breeding. There are good evolutionary reasons for expecting to find paternal care only when the male can be fairly confident that the offspring he is caring for are really his own and thus share his genes. In species forming multi-male troops like the baboons and macaques, males can have no such confidence. Baboon and macaque troops contain numerous breeding adults of both sexes, and sexual relations tend to be rather promiscuous. It is not surprising that a male baboon generally gives no direct care to infants, since he has no way of knowing which infants are his own.

Another feature shared by gibbons,

titi monkeys, marmosets, and tamarins is that in all of these primates, adults of the two sexes tend to be nearly equal in size. In some cases, the female may even be a little larger than the male. This is in marked contrast to the baboons and macaques, in which adult males are in general much larger than females. Thus it seems that what appears to be a more equal sharing of parental duties goes hand in hand with equality in body size.

Sexual Dimorphism

Interestingly, the human species is intermediate in sexual dimorphism (that is, the degree of size difference between the sexes) as primates go. Human males tend to be larger than human females; but the difference is nowhere near as great as in, say, baboons. This fact has led some anthropologists to speculate that, among our not-too-distant ancestors, males had little involvement in caring for the young. Human fatherhood may be a relatively recent evolutionary development.

In any event, primatologists for a long time accepted the general rule that monogamy, reduced sexual dimorphism, and paternal care go hand in hand, whereas polygamous or promiscuous species tend to have greater sexual dimorphism and little or no direct involvement of males with infants. However, recent research on species such as the Barbary macaque has suggested that this view may be oversimplified.

The Barbary macaque is a ground-dwelling Old World monkey which forms large troops containing several adults of each sex. Like other macaques, this species is strongly sexually dimorphic. But recent observations, both in zoos and in the field, have revealed that adult male Barbary macaques devote a great deal of attention to infants.

Barbary macaques are best known for being the only monkeys that live wild in Europe, although the only European population is confined to

Gibraltar, just 10 miles from North Africa. (It is possible that the Gibraltar population was introduced by humans, but the monkeys were already there when Moorish invaders entered Spain in the 8th Century A.D.) Far more substantial populations of the same species are found in North Africa, where anthropologist David Taub has studied them extensively over the past decade.

Taub has frequently seen infants riding on adult males' backs. At other times, an infant will cling to the male's abdomen as he walks. A male Barbary macaque will sometimes hold an infant while he is sitting still, cuddling the infant in his lap or allowing it to climb on his shoulders. A male may also groom an infant's fur and run over to retrieve the infant when it cries out because it is lost or frightened.

Taub was able to recognize the individual members of the wild Barbary macaque troop he studied. He found that each adult male does not care equally for all the infants in the troop, but rather devotes his attention to one or two infants, ignoring all others. No one knows how male Barbary macaques are related to the infants for whom they care: Sometimes, the caregiving male may be the father, but often a male may care for a "nephew"—a sister's or half-sister's offspring—or occasionally a younger half-brother.

Field studies of our nearest primate relatives, the great apes, have revealed considerable variation in paternal behavior both within and between species. As far as is now known, adult orangutans tend to avoid one another, so in this species males and young have little opportunity to interact. Chimpanzees have a very flexible social structure, forming groups that contain several adults of both sexes. Adult males usually remain in the group into which they were born, while females transfer to another group on reaching sexual maturity, sometimes returning to their natal group after becoming pregnant. Males are generally tolerant of infants but do

not typically become closely involved with them.

Among gorillas, the usual social group contains only one breeding adult silverback male, along with several of his male kin and several females. As in chimpanzees, females migrate from their natal troops while males remain behind. Silverback males show some interest in infants, playing with them and, at least in some cases, grooming and sleeping with them. But adult male gorillas' major contributions to the welfare of infants in the group are probably indirect. Male gorillas have been known to kill infants belonging to other groups, and one benefit a silverback male can provide is protection against attacks by foreign males.

In 1976, Sarah Blaffer Hrdy electrified the zoological world with an account of infanticide by hanuman langurs in India. In this monkey species, the typical social group is a harem in which a single adult male does all the breeding. Sometimes one male supplants another, and often the new male systematically kills all infants in the group.

Cruel as his behavior seems by human standards, it may make good sense in terms of the male langur's genetic self-interest. The infants he kills have been sired by his predecessor. More recent studies have shown that infanticide does not always occur when a new male takes over a harem. Female langurs have tricks to protect their infants. Nonetheless, accounts of infanticide in langurs have deepened our understanding of the complex nature of male-infant relations in primates.

In ancient Greece, it was said that the Delphic oracle gave the advice, "Know thyself." Today's evolutionary biologists would add, "Know thy close relatives." If we are ever to understand human behavior in all its aspects, we will have to understand other primates. What we find out may amuse us, intrigue us, and sometimes even shock us. But if we are honest, we will admit that we can see a good deal of ourselves in our fellow primates. □

Three of the Zoo's most successful primate fathers are its siamang "Sam" (top), Celebes crested macaque "Michael" (center), and liontail macaque "Gustav" (bottom).



Keepers' Corner

True Tales from Zoo Insiders



Joan Bopst

The Brookfield Zoo once had a Canada lynx named "Missing," along with two others named "Chain" and "Cuff Lynx." Our curator was concerned that use of the name "Missing" in internal reports might cause undue panic, so he sent a memo asking that we "please change Missing Lynx's name to avoid confusion." My co-worker, aiming to please as always, did as he was told. The lynx was promptly renamed "Avoid Confusion."

—Cathi Mathias
Keeper

When the Brookfield Zoo's fruit bats can't or won't take care of their babies one dedicated keeper takes over. He carries the young under his shirt throughout his waking hours, bringing them out to feed. Everyone knows not to pat this keeper's back or grab his shoulders—but just in case someone might forget, the other keepers are considering getting him a shirt stamped with the familiar yellow diamond, reading "Bats on Board."

—Cathi Mathias
Keeper

About 20 years ago, on a weekday morning when few visitors were at the Zoo, a keeper noticed that the snow leopard's enclosure was open—and empty!

Word spread quickly throughout the Zoo, and NZP police marshalled their forces. They knew how rare and valuable this animal was, but also how potentially dangerous—so, hands resting cautiously on pistol handles, they searched the Park grounds as tension mounted.

After a short search, the ferocious-looking animal was discovered crouched in a clump of honeysuckle. Now, the police were faced with the problem of returning the leopard to its enclosure. Should they send for immobilizing darts? Nets? The SWAT team?

Wisely, they first phoned for head keeper Ralph Norris, who promptly arrived on the scene. To the utter astonishment of onlooking Zoo staff, Norris casually strolled up to the leopard, murmured, "C'mon sugar baby, come with daddy," then turned and marched toward its cage—the huge feline following closely behind, as meek as any kitten.

—Billie Hamlet
NZP Historian

Over millions of years in the wild, sloths have developed some impressive energy-saving techniques. Most obviously, they move at an agonizingly slow pace, bask in the sun to speed their digestion, and stick to a narrow home range of trees. But it was a captive sloth that brought the animal's true knack for energy conservation home to me.

Now, one reason most zoos have two-toed sloths instead of their three-toed cousins is that the three-toed sloth is very difficult to maintain in captivity. For one thing, its diet is so highly individualized and its digestion so slow the animal can literally starve to death with a full stomach. So, when the National Zoo had a pair of three-toed sloths, keepers hand-fed them every day to make sure the animals received proper nutrition. This feed-

ing was one of my favorite tasks, and a very peaceful part of the workday—until one morning when the normally placid female, Lady Baby, became restless and refused to eat. She sat on my lap as usual, but would not be tempted by applesauce, cereal, or even succulent leaves.

Finally, the reason for Lady Baby's odd behavior literally fell into my lap. She was giving birth! In true "slothful" fashion, she had saved herself and her infant the trouble of clinging to branch and body during birth—the usual sloth procedure—by relaxing right there in my lap throughout labor.

Perhaps the birth was just a coincidence, but I prefer to think of it as one more lesson the sloth has to offer us humans in energy conservation.

—G. Maliniak
Retired Keeper

I recently sat in on a classroom lesson to a fourth-grade group that was participating in a six-week program at the Zoo. Filling time while the film projector was being set up, the teacher asked the children if they could remember who worked at the Zoo. Hands shot up around the room.

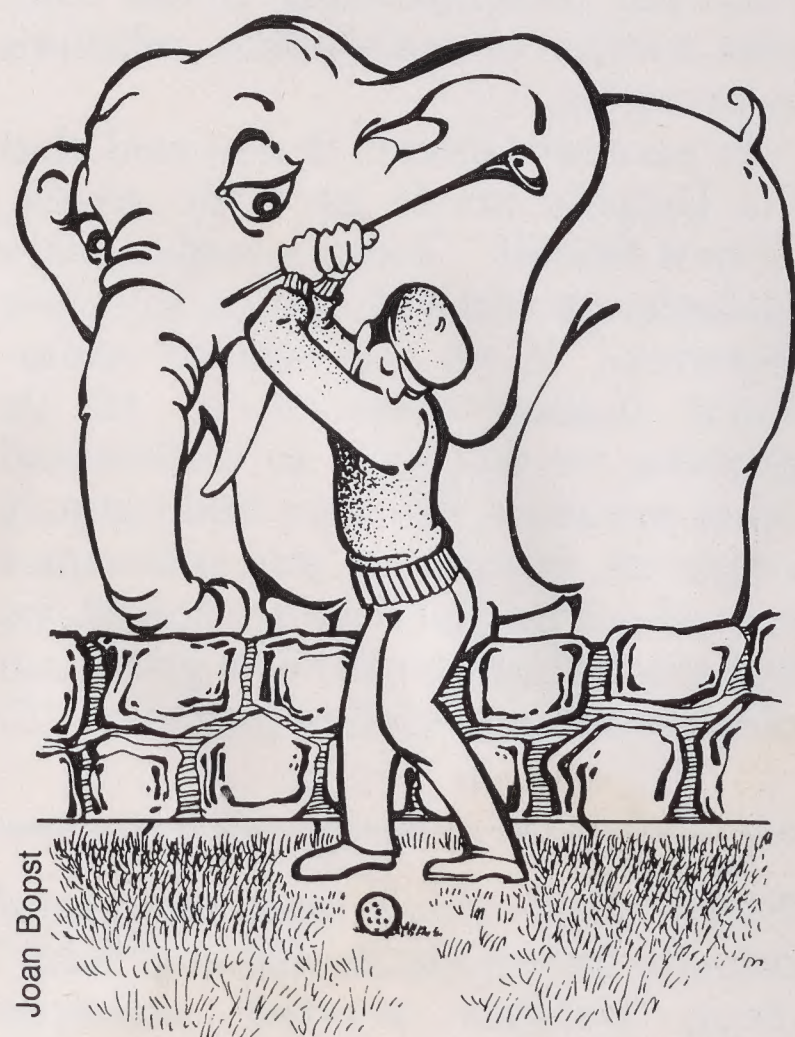
"Keepers," said one child.

"Veterinarians," said another.

"Guides," answered a third.

"And then," said a fourth child thoughtfully, "there are all those people that drive around in golf carts."

—Sharon Barry
Education Specialist



Joan Bopst

A Guide to the National Zoo's Invertebrate Exhibit



Chambered nautilus (photo by Jessie Cohen, NZP Graphics)

World of Wonder

Howard Youth

Question: Which animals provide the backbone of evolution though they themselves are spineless? Hint: As a group, these creatures vary dramatically in size, ranging from microscopic specks to deep-sea giants reaching up to 60 feet in length. Some can live out their lives in a spoonful of water, while others swarm to cover thousands of square acres of land.

Answer: Invertebrates—amazingly adapted creatures which perhaps outnumber vertebrate species 99 to 1.

The National Zoo's Invertebrate Exhibit provides a wonderful introduction to some of the most ancient members of the animal kingdom. Exhibit tanks and opportunities for hands-on experimentation offer a well-rounded view of invertebrate life; interpretive signs and staff are on hand to answer questions.

Entering the Invertebrate Exhibit through a ground-floor entrance at the rear of the Reptile House, visitors are immersed in a glowing world of wonder. The first tanks provide an overview of invertebrate life, followed by a series of exhibits that traces the path of invertebrate evolution.

Warmwater Seas

The stunning diversity of a Caribbean coral reef is highlighted in the Invertebrate Exhibit's first display. What appears to be an underwater garden is in fact a miniature habitat comprised entirely of animal life. Live brain and fan corals make up the reef, a rocklike structure covered by a thin layer of countless soft-bodied animals called coral polyps. A closer look may reveal the tiny

polyps extending their tentacles in search of unsuspecting brine shrimp at feeding time.

The stone-like base of the coral reef is lifeless, a composite of the outer "skeletons" of dead and living polyps. The coral provides homes for burrowing orange tube-worms, whose feathery feeding structures peek like blossoms from the reef. Long-antennaed spiny lobsters prowl the reef in search of food, and candy-striped banded coral shrimp seem to tiptoe daintily over the coral heads.

Three types of sea urchin, as well as smooth-shelled cowries, traverse the tank in search of invading algae. Large, flower-like anemones, close relatives of the tiny corals, further enliven this tropical scene.

As in almost any healthy environment, competition is the rule of the reef, where different types of coral vie for space. Upon close inspection, you may notice that one type of coral seems to be crowding another. Eventually it may kill off the less aggressive species, or a portion of it, and replace it with its own extension.

Coldwater Seas

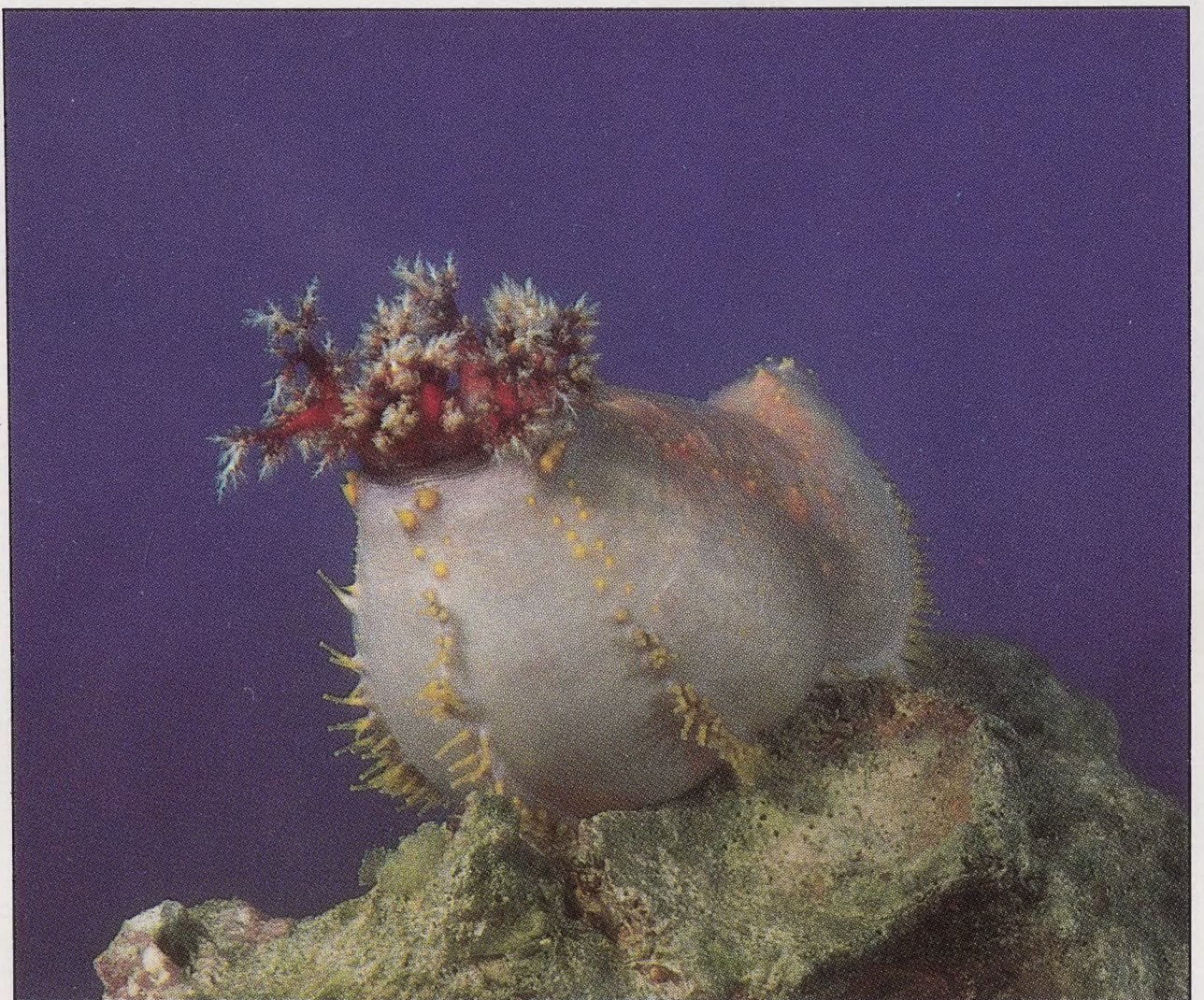
A living picture of life in Northern Pacific waters provides a second window on invertebrate habitats. In this colder climate, animals are often larger than those in warmer regions—possibly an indication of slower growth and longer life. Abundant anemones, resembling rubbery flowers, burst brightly from the rocky surroundings, waving their tentacles in search of prey. Sea stars share this watery world and move about it slowly with the aid of unique tubefeet which line the undersides of their arms.

Jessie Cohen, NZP Graphics



Sponge

Jessie Cohen, NZP Graphics



Sea cucumber

Microscopic Life

An evolutionary journey begins at a video display that conjures up images of life's watery beginning. "Alien" creatures, magnified to the size of pancakes, squiggle and slither before your eyes; most are transparent and move by lashing whip-like "tails" or through a pulsing motion. These creatures are actually living in a pond water sample that has been placed under a microscope by a volunteer. Here, one-celled animals rub shoulders with colonial animals that may represent an important evolutionary step—the combining of single-celled animals into one organism that benefits from a division of labor. A common example of this is the ball-like *Volvox* that may roll past you on the screen. The more complex multicellular animals have a division of labor among their own cells which enables them to develop more elaborate structures for feeding and movement. Some of the legged, buglike creatures you may see are actually crustaceans, a group that probably evolved much later than the one-celled animals with which they share a drop of pond water.

Sponges

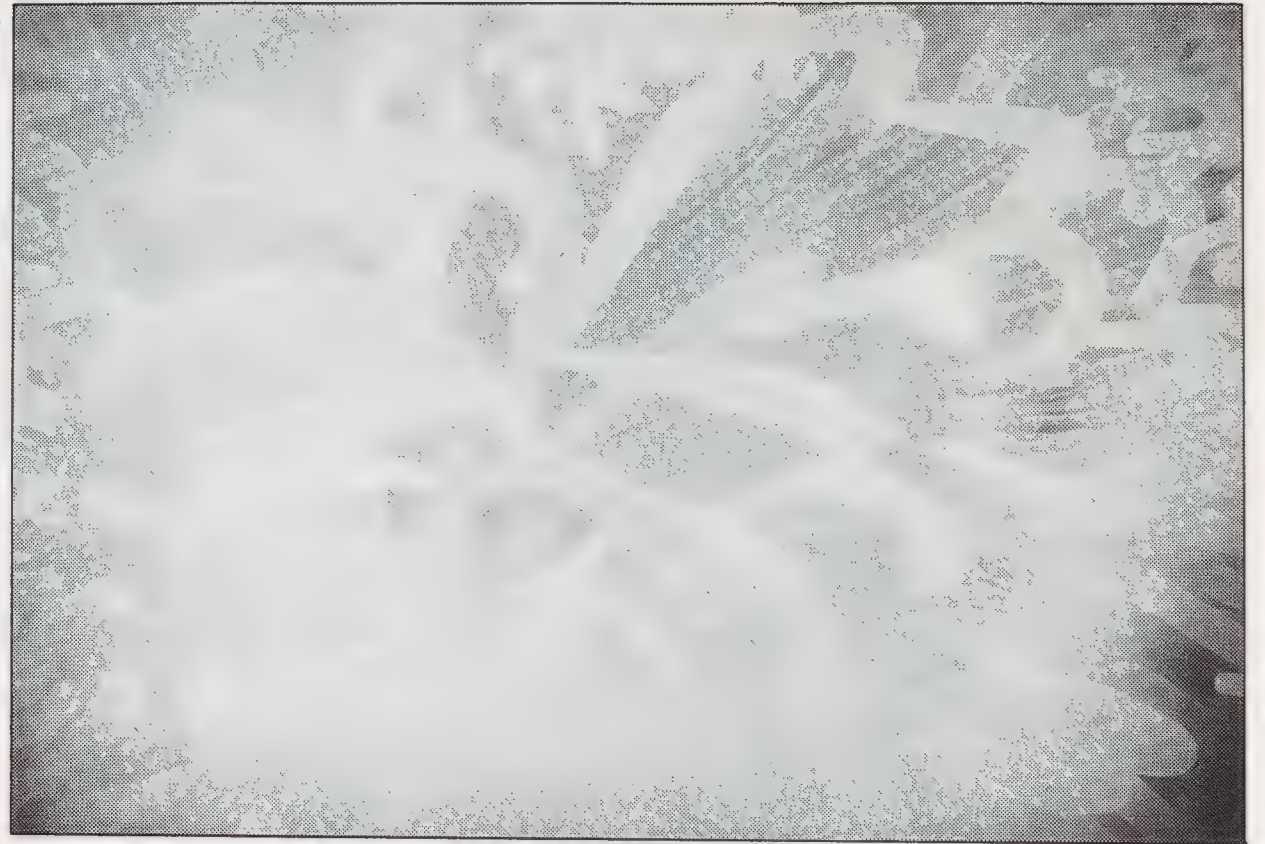
The cherry-red sponges in the next display look more like aquatic cacti than animals. In fact, they are made up of thousands of colonial animal cells that share an interesting division of tasks: One type of cell creates the skeleton of the sponge; another regulates the constant flow of water through the sponge's central cavity and the countless pores that pock its surface; a third type of cell assists further in the regulation of water and also absorbs food particles as they flow through.

About 5,000 species of sponge, ranging in color from red to black, occur worldwide, mostly in oceans.

Cnidarians (nid-AIR-ee-ans)

Deceptively delicate in appearance, the pink-tipped anemones that wave their tubular tentacles are actually animals with the beginnings of a nervous system. The

Milton Tierney



Anemone

Milton Tierney



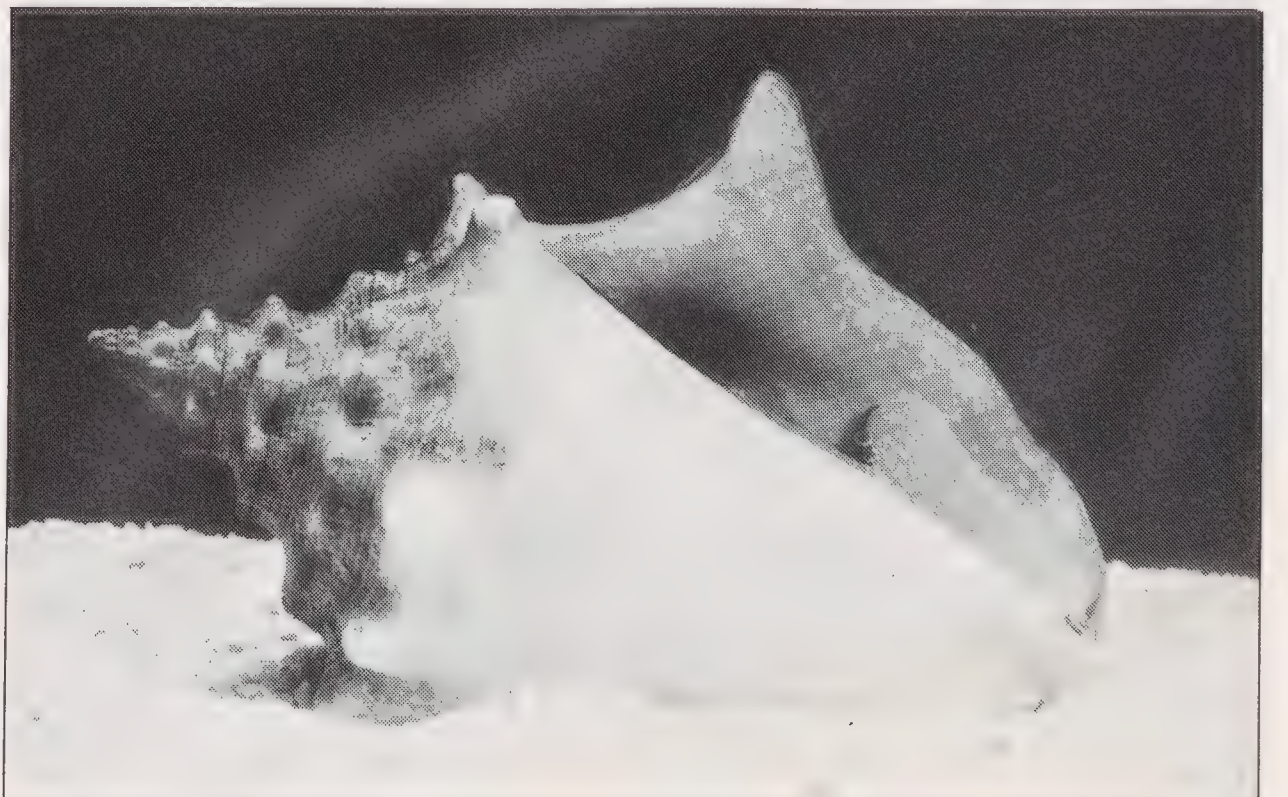
Sea urchin

Jessie Cohen, NZP Graphics



Coral

Jessie Cohen, NZP Graphics



Conch



Cowry



Whelk (with a cowry and anemone on its shell)



Nudibranch

name cnidarian means "animal that stings." Many cnidarians use stinging tentacles to paralyze the fish, tiny shrimp, and other creatures they feed on. Anemones share membership in this group of soft-bodied animals with jellyfish, corals, and the infamous colonial Portuguese man-of-war that terrorizes bathers in warmer oceans.

The remarkable tentacles and stinging cells have elevated a few cnidarian species to record-setting status. For example, the Arctic giant jellyfish may exceed 240 feet from the tip of its tentacles to the top of its bell-shaped cap—more than twice the length of a blue whale. The Australian box-jelly runs a close second in length, but is better known as one of the most dangerous animals in the world. Its sting can kill a human within 30 seconds!

Echinoderms

Named for the horny coverings typical of this group's varied species, echinoderms range in appearance from colorful, sausage-shaped sea cucumbers to spiky sea urchins. Sea stars, or starfish, and their more delicate cousins, the brittle and serpent stars, are also members of this invertebrate group. Many echinoderms, such as sea stars, have tiny, suction-producing tube feet that use changes in water pressure to create movement, functioning much like the hydraulic brake system of a car. In addition to movement, echinoderms may also use their tube feet for feeding and respiration.

Found exclusively in marine environments, echinoderms show a five-part symmetry, which means that the body parts of these rounded creatures usually occur in multiples of five. For example, sea stars have five arms, while sea urchins bear rows of spines that add up to a multiple of five. As you watch the sea cucumber sluggishly patrol the tank it shares with other echinoderms, count the rows of colorful bumps that run down its back—is the total divisible by five? Evolutionarily speaking, echinoderms are more sophisticated than the cnidarians in that they have more rapid control over their movements.



Thorny oyster

Segmented Worms

Parchment-wrapped twigs? Feathers sprouting from rock?

Appropriately named, the creatures housed in the next exhibit are parchment and featherduster worms, two filter feeders that pick up drifting food particles in their feeding apparatus. With their repetition of body segments, these worms represent a new direction on the evolutionary ladder. Some segmented worms, like the parchment and featherduster species, form protective structures in which to live; others are more exposed. Occurring on land (like the familiar earthworm) and in fresh and saltwater, segmented worms are capable of fluid motion because their bodies consist of a tube within another tube. This increased mobility enables them to move over wide areas in search of food and mates.

Mollusks

The familiar clams, oysters, octopuses, snails, and slugs are all mollusks. This classification includes the soft-footed gastropods, such as conchs, cowries, tritons, whelks, murexes, and hinged bivalves or split-shelled mollusks. Thorny oysters and scallops are two species that represent the diversity of habits among members of the latter group: The oysters attach themselves to a surface, while the scallops use jet propulsion to scoot over the sand.

Many gastropods (the name means literally "stomach-foot") travel on a mucous-producing foot, and are protected by a shell which they excrete from a structure known as a mantle. This shell grows with the animal throughout its life. The cowry's beautiful, lustrous shell is a by-product of the mantle which extends far over its shell, protecting it from weathering and the attachment of other organisms. At the other end of the spectrum are the nudibranchs, sometimes called sea slugs, shellless gastropods that occur in a wide variety of shapes and forms. Some nudibranch species feed unharmed on sea anemones, acquiring the cnidarians' stinging cells for their own protection.

Jessie Cohen, NZP Graphics



Banded coral shrimp

Jessie Cohen, NZP Graphics



Cuttlefish

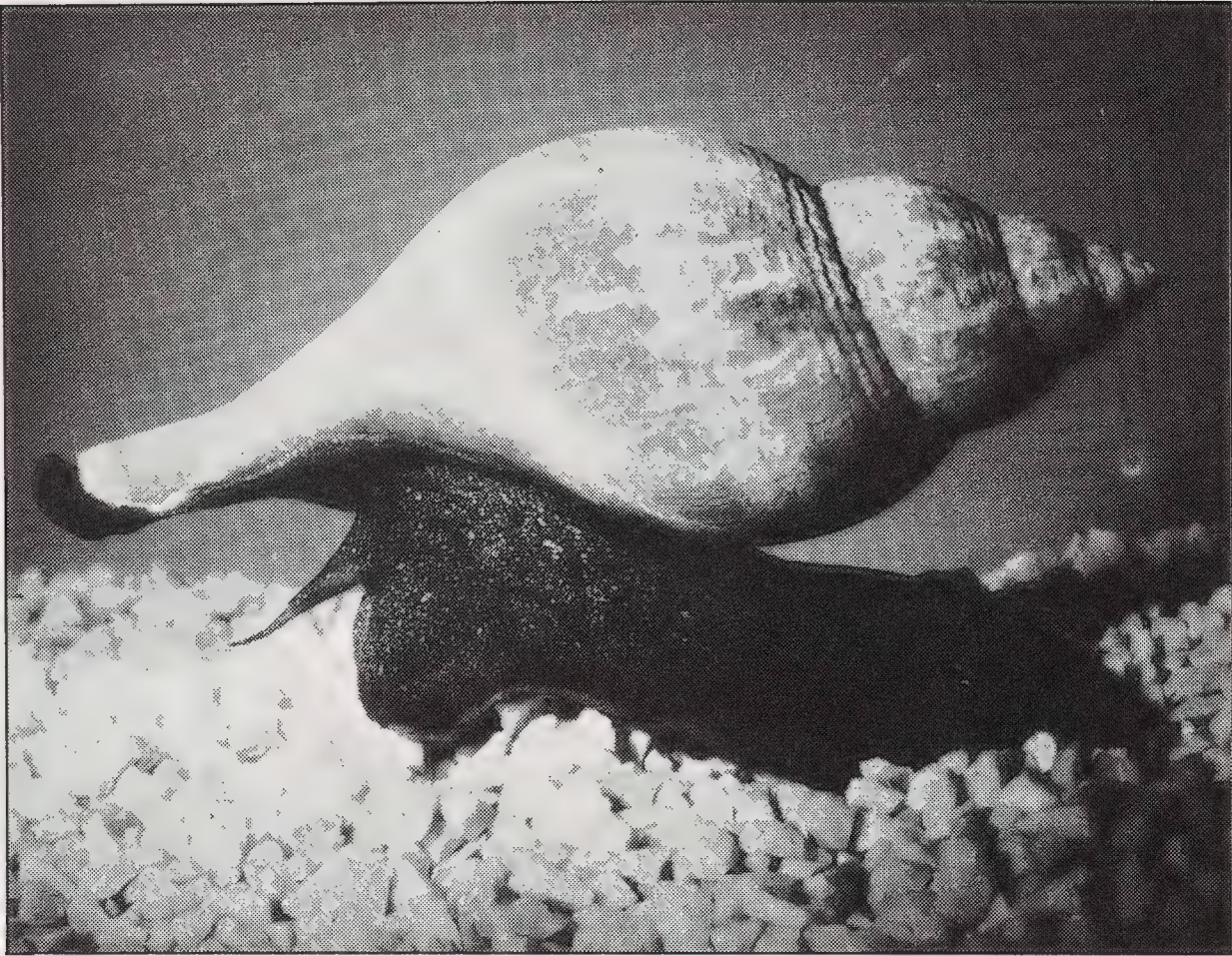
Jessie Cohen, NZP Graphics



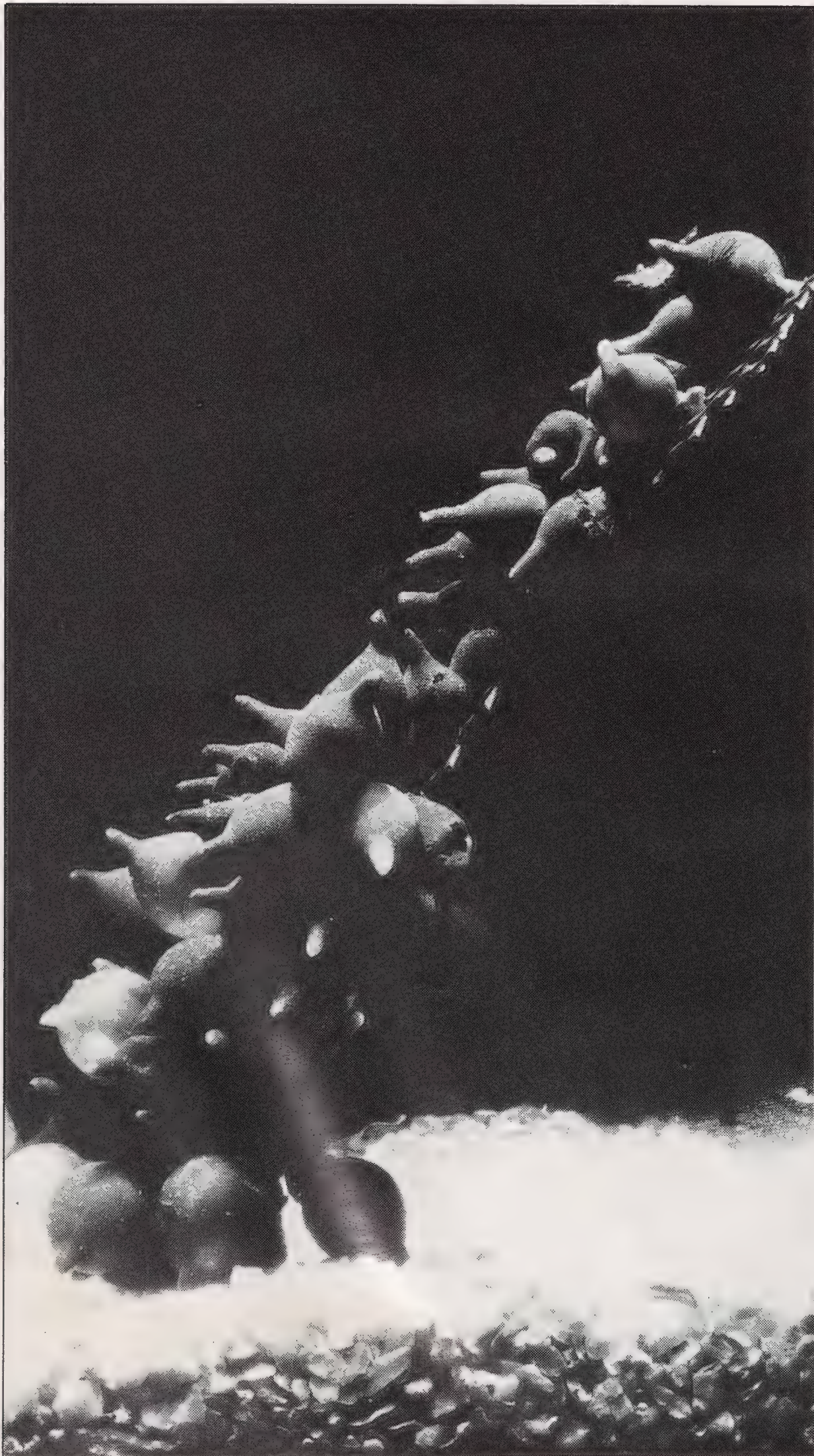
Octopus eggs



Octopus



Tulipshell



Cuttlefish eggs

One intriguing branch of mollusks, the cephalopods (meaning literally "head feet"), is often hailed as being the smartest group of invertebrates. Cephalopod species include the chambered nautilus, cuttlefish, octopus, and squid.

The chambered nautilus is the most primitive member of this group, and indeed is reminiscent of the gastropods because of its shell. The animal's small body occupies the last two inches of its shell, while the remaining series of hollow, spiraled chambers is used for adjusting buoyancy in the water. The nautilus moves by jet propulsion, expelling water from its siphon.

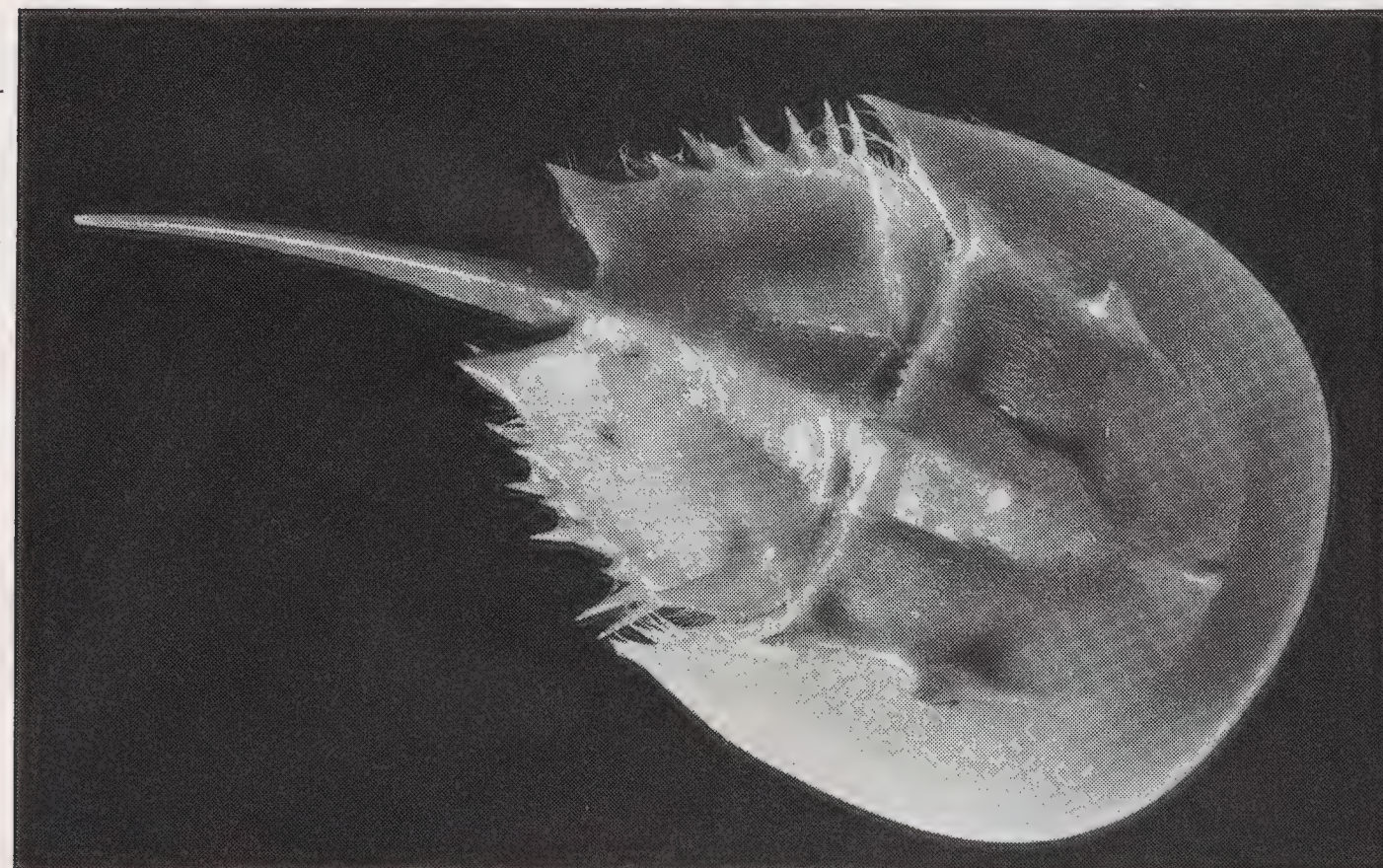
The unshelled cuttlefish (housed in the exhibit's second tank, although individuals can also be seen in various other display tanks) also uses jet propulsion. In addition, it often uses the fins that fringe its elliptical body to orient itself in the water. Cuttlefish retain a porous remnant of their shell under the skin; like the nautilus' chambered shell, this "cuttle bone" is used to adjust buoyancy. Cuttlefish display a proficiency at color change, altering their skin color instantaneously according to mood. Color changes are often used as signals between individuals, and you may see one sandy brown cuttlefish turn black if alarmed by another.

The solitary octopus frequently uses its color-changing ability for camouflage, changing patterns and hues to suit its surroundings or mood. Lacking a protective shell, the octopus must rely extensively on camouflage and hiding. Free-moving arms enable it to move across the ocean floor, while jet propulsion provides a speedy escape mechanism.

The Pacific giant octopus has been found to have a greater brain-to-body ratio than most fish and reptiles. The memory and learning skills of these animals enable them to negotiate mazes and find food hidden behind coded doors. The capacity of this inquisitive, highly developed animal to wander is not underestimated by the exhibit's staff, who must make special efforts to ensure that these enterprising mollusks don't climb out of their tanks!

Arthropods

Sometimes as abhorred as they are abundant, arthropods play a central role in the life of our planet's ecosystems. Concentrations of krill, a tiny shrimp-like



Horseshoe crab

crustacean, are a vital food source for whales, seabirds, and other marine life, while terrifying swarms of desert locusts, a type of grasshopper, occur in such numbers that they can cover thousands of square miles, demolishing grain crops in a matter of hours.

From crabs to cockroaches, the amazingly diversified arthropods are typified by their armored external coverings and jointed appendages, which are often specialized for performing different tasks. Unlike skin, an arthropod's protective "armor" must be shed as the animal grows. Taking self-defense one step further, the hermit crab relies on the additional protection afforded by the empty gastropod shells it finds on the sea floor. It has adapted to a shell-carrying life by developing reduced legs and a soft tail—parts that help anchor it to its mobile home.

Crabs, lobsters, shrimp, crayfish, barnacles, and many other arthropods make up the crustacean group. Notice the different types of crustacean appendages. The lobster, for example, sports two pairs of sensing antennae, three pairs of mouth parts, three pairs of food-handling legs, two protecting and food-gathering claws, four pairs of walking legs, and small appendages near the tail that aid in swimming.

The formidable insects make up another prominent arthropod group. Perhaps as many as 30 million insect species fly, hop, or crawl over every part of the earth except in the oceans. Visitors can view a few of the most intriguingly adapted insects at the Invertebrate Exhibit. The bizarre walkingstick, for example, looks more closely related to a weed than a cockroach!

A colony of social leafcutter ants occupies one wall, with a trail leading from a plant food source to the elaborate colony that includes a fungus garden and nursery area. A queen ant establishes the colony, which is eventually turned over to a variety of laborers. The queen then concentrates on egg-laying. Ants of different sizes perform specialized tasks. Soldiers, armed with formidable jaws, work but also protect workers as they carry pieces of leaves to the colony; others use the leaves to set up a fungus "farm," the food source of the colony. All of the ants' activities are visible through the exhibit's glass covering.

The arachnids are a group of arthropods closely related to their six-legged relatives, the insects. Arachnids, including scorpions, mites and ticks, and spiders, possess eight legs. One arachnid display shows the different ways

Jessie Cohen, NZP Graphics



Tarantula

Jessie Cohen, NZP Graphics

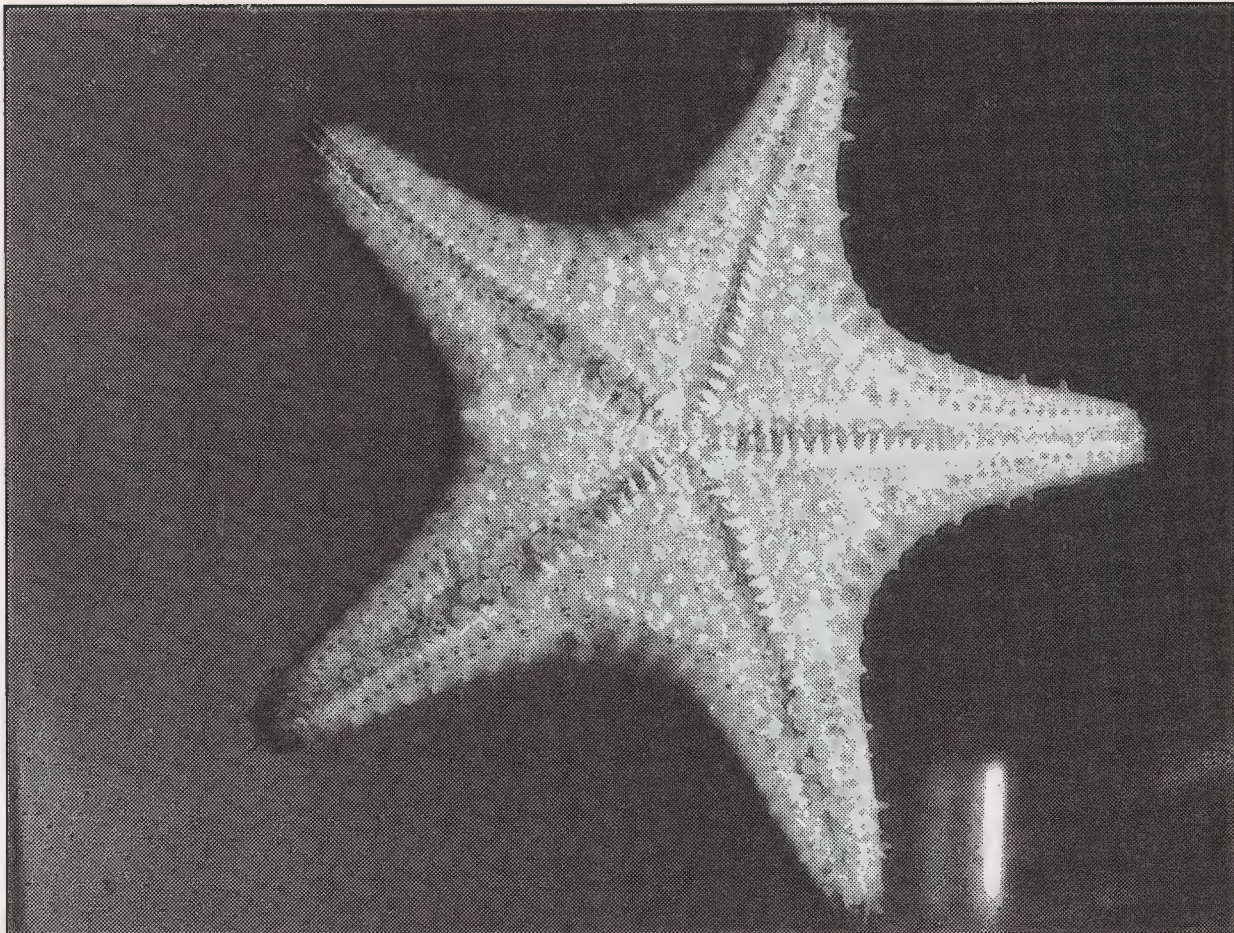


Sea squirt or tunicate

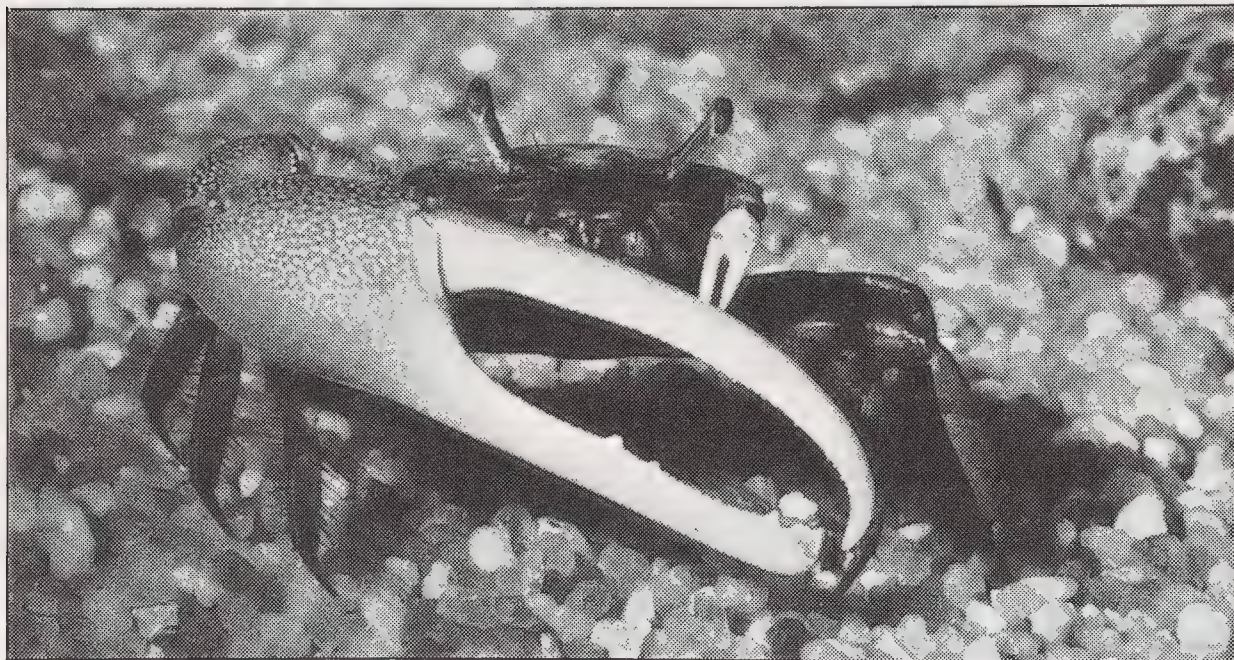
Milton Tierney



Hermit crab



Starfish (underside)



Fiddler crab



Scorpion

spiders have adapted to catching prey, while another allows visitors to come face-to-face with scorpions, fierce-looking arachnids of warmer areas.

The familiar horseshoe crab is not a true crab, although like the crabs it is an arthropod. These spine-tailed "tanks of the deep" have been called living fossils because their body plan has remained virtually unchanged since the Paleozoic Era (well before the dinosaurs). Millions of these harmless creatures haul up on local beaches in late spring to mate and lay eggs.

Missing Links?

Providing an appropriate endpoint to the Invertebrate Exhibit, the adult sea squirts or tunicates are fixed, sac-like creatures with two openings. Water flows in one opening, passes through a filtering apparatus which catches food particles, and is expelled from another opening. As larvae, these creatures are quite different—they have tadpole-like tails and internal rod-like structures known as notochords. The notochord is thought to mark a crossroad in the development from invertebrate to vertebrate forms of life.

Active Learning

The Invertebrate Exhibit is designed to challenge teen and adult zoogoers. Visitors are encouraged to ask the staff questions and to view public feedings of the exhibit's animals. Visitors are also encouraged to take their time in the "sit and browse" educational area located around the corner from the permanent display tanks. Here you will find display tanks with magnifying glasses that offer a close-up view of small invertebrates. These displays will be changed frequently, so you may see new animals on each return visit. Microscopes surround a large soil sample where you can examine a wealth of animals we often encounter but never see.

In the core of the exhibit is the staff area, where Zoo scientists study a variety of invertebrate species, including a 20-pound lobster that may be close to 50 years old. A unique breed known as the invertebrate staff is also in this area. They will be happy to assist you in unraveling any mysteries you encounter in this spineless Garden of Eden. □



Flame box crab

In Search of Jalak Bali

Susan Lumpkin

A flash of white—and then another—our quest was complete. There, not 50 feet away, foraging in the crown of an acacia was Jalak Bali, the celebrated island of Bali's most fabulous bird, and its most rare. We silently watched this pair of survivors, well aware that they were among the last of their species living in the wild, living in the last of Bali's wilderness.

Jalak Bali, variously known as the Bali mynah, Bali starling, Rothschild's mynah, and to scientists as *Leucopsar rothschildi*, is by any name breathtaking. Velvet black wing tips, bright blue cheeks, and dark legs offset the bird's shimmering whiteness; a feathery crest is its crowning glory. By any name it is uniquely Balinese, for the mynah lives only on Bali and is the island's only endemic bird.

But the spot that nurtured this native species is a far cry from the lush landscapes of Bali, so rich that the human inhabitants believe heaven will be just like home. As if to ensure that no corner of the island is bereft of flagrant beauty, the mynah resides in the barren savanna that borders the northwest shore. This austere area links the forested volcanic slopes rising abruptly from the seacoast to the rim of mangrove swamps and coral reefs. It is the core of the nearly 200,000-acre Bali Barat National Park: a final refuge for the Bali mynah and all the island's wildlife.

Fortunately, the bird has also found refuge in zoos. Discovered by Western biologists in 1911, the species quickly became a favorite of zoos and cage-bird fanciers. To fill the demand, bird traders took hundreds of these beautiful birds from the wild, a practice that contributed to the species' decline. Little effort was made to breed the mynahs in captivity, for until recent years, most zoos were dedicated to filling their limited aviary space with the greatest possible variety of species rather than displaying and caring for many individuals of the same species. Breeding insectivorous and fruit-eating birds like Bali mynahs

in captivity is also more difficult and time-consuming than breeding seed-eaters, so it was seldom attempted.

All this has now changed. Since the early 1970s, when breeding and maintaining large populations of endangered species became a priority of zoos around the world, the Bali mynah has been one focus of special attention at the National Zoo. Thanks largely to the efforts of former NZP bird curator Guy Greenwell, Jalak Bali now breeds prolifically in captivity—so much so that for the captive population, the problem is too many birds, not too few. The wild population has not fared as well, dwindling from more than 200 to fewer than 60 individuals during the same time period.

Diminutive Tigers

It was in hopes of seeing one of the rare wild starlings that my husband John Seidensticker and I set off, with our three-year-old daughter, in search of Jalak Bali. For John this was a sort of homecoming as well. Ten years ago, he spent months combing the remotest reaches of Bali Barat's forests for sight or sign of the diminutive Balinese tigers that once lived there but, as he found, are now extinct.

This is not, however, a tale of intrepid adventure. Once the northwest corner of Bali was virtually uninhabited except by noisy groups of long-tailed macaques and silver langurs and by tigers who preyed on abundant banteng and rusa deer; until the late 1930s, no road even came close to the area that is now the national park. Today Bali Barat is as accessible to the island's visitors as Shenandoah National Park is to Washingtonians. But good roads are often bad news for wildlife.

So far as is known, the Bali mynah has never been widely distributed. Although naturalists in the first half of the century found the mynahs fairly abundant (they were often seen in large flocks of 30 to 60 individuals), none were ever seen—and naturalists

did look—outside the northwest coastal area. The present small population of Bali mynahs may be the last remnants of a once widespread species, now in the final throes of a centuries-old extinction process. Conversely, the bird may truly be a local endemic, the evolutionary descendants of a population of another species of starling that through some fluke became isolated in this corner of Bali, diverged from the parent population, and then were unable ever to expand their range. A third possibility is that the mynahs were specially bred temple birds brought with the Hindu religion from India; perhaps some escaped and, in the absence of other avian competitors, became naturalized but, again, were unable to expand beyond a small area. Until more research is done, how and why Jalak Bali evolved as the island's only endemic remains a biological puzzle.

What is known, however, is that the species shuns people. The human population in northwest Bali has increased dramatically in the last 50 years as people have been forced to cultivate marginal land, or starve. Along much of the coast, and even within the national park, coconut plantations cover what was once Jalak Bali's monsoon forest habitat, constricting the bird's already small range. Natural-cavity nesting sites disappeared as trees were felled for timber and firewood. With human settlements came large numbers of blacked-winged starlings, which thrive in cultivated fields and compete with less numerous Bali mynahs for available nesting sites. So as the human population grew, the mynah population declined, with poachers and bird-traders adding to the misfortune of the precariously surviving species.

The remaining wild birds—about 60 individuals—live primarily in two small sections of the Bali Barat, areas that are themselves islands in a sea of coconut trees. With the kind permission of the park director, we were taken by boat to one of these guarded,

The present small population of Bali mynahs may be the last remnants of a once widespread species, now in the final throes of a centuries-old extinction process.

inaccessible sites on the tip of the arid Prapat Agung Peninsula. Gaunt acacia, hibiscus, and tamarind trees, resistant to frequent natural fires, dominate the peninsula's landscape.

The Real Thing

From where we landed on the beach, a dusty trail rose steeply through the prickly black stubble of a recent burn. As we climbed, the guides explained that each day before sunset, the 16 local mynahs left the thickly forested higher elevations they frequented by day and returned to roost in the sparser vegetation near the coast. Our timing had been good—it was now about 3:30 p.m. When we reached the high ground overlooking a roost site, we scanned the acacias and the sky. And waited.

Once, twice, three times we were tricked into hope by the blacked-winged starlings, which are remarkably similar in appearance to the birds we sought, but much more common. We saw a tiny muntjac step carefully out of the tree cover—and crash right back in at the sight (or smell) of us. John quietly pointed out the tracks of a civet, a rusa, and the rootings of wild

pigs. And then, there they were. First one white flash, then another, and a distinctive call confirming that these were not the blacked-winged imitators, but the real thing: wild Jalak Bali.

We watched the pair search the acacias for food, scarce at the end of the dry season. Heads cocked, they poked their strong bills into the tree bark, forcing open tiny cracks to reveal ants and other insects. They flew heavily from acacia to acacia repeating this process over and over, but clearly wary of our presence. After about 30 minutes, we tried to get closer, descending toward the trees, but as if aware of our motives, the birds flew over our heads to the high ground we had just left. Suddenly, while our attention was diverted by a small dust storm, they were gone. A perfect metaphor for the larger situation: There is hope for Jalak Bali's survival in the wild with the protection they are now given in the park, but if that protection lapses, even briefly, wild Jalak Bali may be gone forever.

There is also hope for the species in the large, self-sustaining captive population. The National Zoo is cooperat-

ing with other zoos, the International Council for the Preservation of Birds, and the Indonesian government to develop a reintroduction program for the species. With more than 600 birds in captivity—10 times the number left in the wild—the captive population is now secure enough to begin sending colonists to resettle the wild. Later this year, mynahs from North American zoos will be transferred to Indonesia for captive breeding, and progeny from these birds will be released into the wild.

Tired, wet, dusty—and exhilarated—we sailed back amidst spectacular vistas. To the west, the sun was setting behind the towering volcanoes of East Java. To the east, storm clouds were gathered over the distant shore. To the north and south, the forested ridges of tiny Menganan Island and Prapat Agung. Below the water, immense schools of gaudy fish swam near the coral reef.

We landed with the sudden tropical night and ended our adventure with the hope we might return—that our daughter might return—10, 20, or 50 years from now to search for Jalak Bali—and find them. □

Jessie Cohen, NZP Graphics



Bali's striking mynah (left) is making a comeback in captivity, but its tigers (right) are extinct.

Why Turtles Bask

Marianne Hughes

Turtles basking beside the pond in front of the Reptile House often seem to spend hours without moving at all. To busy humans, it is tempting to think of basking as a way of relaxing or even wasting time. But scientists studying basking in turtles have learned that this behavior plays an important role in turtles' daily lives. Basking enables turtles to regulate their body temperatures so that they are neither too cold nor too warm.

Like all members of the animal kingdom except birds and mammals, turtles are ectothermic or "cold-blooded." Ectothermic animals rely on the surrounding temperature for heat, unlike the endothermic birds and mammals which rely almost exclusively on metabolism. Also, turtles have no layer of insulation—such as feathers or fur—to keep body heat in and extreme environmental temperatures out. Yet turtles need to reach body temperature ranges similar to those of birds and mammals in order to be active. At very low temperatures, they are unable to feed, mate, or escape predators; very high temperatures can kill them. And in many parts of the world, environmental temperatures may fluctuate widely over the course of a year—or a single day. Turtles solve this dilemma by regulating their body temperatures behaviorally.

Of course, one way to minimize the problem of temperature regulation would be to live where daily and seasonal temperature variations are slight; and of the more than 200 turtle species now in existence, a large proportion live in tropical and subtropical regions of Africa, Asia, and South America. But about 55 species live in temperate North America. Many of these North American species have been the subjects of detailed studies of behavioral temperature regulation.

A great deal of what is now known in

this area of research has been learned from turtles of the family Emydidae. This family includes turtles that live in ponds or lakes, such as the painted turtle, red-eared slider, and spotted turtle. During their active season, spring through fall, these turtles leave the water to bask shortly after sunrise. Partly submerged logs are good places to look for basking turtles, and on a cool spring morning they may bask for several hours. Painted turtles arrange themselves so that their "broad sides" are facing the sun, which gives them maximal exposure to sunlight. Painted turtles also offer a clue about the importance of basking to turtles—they fight over spaces on a good basking site, with some individuals getting pushed back into the water. Spotted turtles, on the other hand, compete in their own way, piling up on basking sites with late-comers basking on their neighbors' backs.

Once they are warm enough, pond turtles return to the water to feed and, in spring and early summer, to mate. In mid-summer, they may actually need to get out of direct sunlight to avoid overheating. But if the water is cool, the heat gained by basking is soon lost; so turtles may bask several times a day. Leaving the water has its risks for young turtles; they are food for herons, snakes, and some mammals. Young painted turtles bask more briefly than do adults. They are also less likely to leave the water to bask, being found instead at the edges of ponds with only their shells exposed to the sun. By these modifications in their basking behavior, young painted turtles may be reducing their danger of predation.

Basking may be useful for more than just getting the turtle warm. Drying of the skin during basking may help to control parasites, such as leeches. Also, female turtles of several species spend more time basking in spring than do males, suggesting that basking has a role in preparation for egg-laying. These hypotheses have not been tested experimentally. But many behaviors are known to have more than one function.

The family Kinosternidae includes turtles that spend even more time in water than do the pond turtles, and these species have adapted behavioral temperature regulation to their specialized way of life. One of the most familiar representatives of this group is the musk turtle or stinkpot, which is found throughout the eastern United States. This species actually does little swimming, compared to the pond turtles. Instead, it gets about by walking on the muddy lake or river bottoms which seem to be its preferred habitat. The musk turtle was believed by naturalists of the last century never to leave the water, except for the yearly trip ashore by the female to lay eggs. In the Northeast, this statement has been found to be very nearly true. The musk turtle regulates its body temperature by a behavior that has been called "aquatic basking"—resting on mats of vegetation on the water surface with only its top shell, or carapace, exposed to the sun. In the South, musk turtles bask in the more conventional way, but on cypress "knees," knobs of roots partly above water level.

Why doesn't the musk turtle go onto land to bask? One hypothesis is suggested by its shell. The bottom shell, or plastron, of the musk turtle does not completely cover the underside of its body. Even with its head and legs drawn under the carapace this species has areas of unprotected flesh which a predator could reach simply by rolling the turtle over. Basking in, or surrounded by, water may have evolved by reducing the danger of predation for a more vulnerable species. Other aquatic baskers include several species of soft-shelled turtles and even young snapping turtles, whose undersides are also not completely covered by the plastron. Perhaps not coincidentally, these species also have in common a reputation for feistiness—unlike the pond turtles, they are not reluctant to bite.

Even marine turtles may bask occasionally. Green turtles have sometimes been sighted crawling ashore in

Zoologist Hughes teaches at the University of Iowa, where she has done extensive research on behavioral temperature regulation in turtles.

the Galapagos Islands around noon, presumably taking advantage of the midday warmth. But because the green turtle has been hunted so extensively, the number of beaches where it will come ashore has diminished considerably. Another option for sea turtles is aquatic basking. Physiologists studying the leatherback turtle found that individuals floating in cold water (40° F) could have deep-body temperatures as high as 79°. The leatherback accomplishes this feat by reducing its peripheral circulation—the flow of blood to the skin and flippers. So, warmth gained by aquatic basking is not carried to the skin and lost, but “trapped” within the turtle’s body. This phenomenon is not unique to the leatherback; a number of turtle species enhance the effectiveness of basking by physiological means.

At the other end of the spectrum is the family Testudinidae, the land-

dwelling tortoises. Life on the land has imposed on the tortoises a different set of problems in temperature regulation. They cannot retreat to the water on a hot summer day; consequently, there is real danger of overheating. Tortoises find shelter from the sun under trees or in rock crevices or burrows. Because of the threat of overheating in the desert, it is not surprising that desert tortoises will fight for access to shade. Gopher tortoises dig their own burrows. A long-term study of gopher tortoises in Georgia showed that the burrows are “summer homes”—different from winter hibernation sites—and that an individual returns to the same burrow year after year, enlarging it a bit each year. The burrows of old gopher tortoises may be 20 feet long and 10 feet underground at their deepest point. In these burrows, the air hovers comfortably close to 68° throughout the summer.

On the other hand, size alone seems to give the giant tortoises of the Galapagos and Aldabra Islands protection against overheating. Full-grown individuals of these species can

weigh well over 300 pounds; tortoises this big warm so slowly that by midday in the tropics their deep-body temperatures are still 25-35° cooler than their skin temperatures. The observation that large reptiles gain or lose heat slowly has suggested the “thermal inertia hypothesis” of dinosaur temperature regulation. The deep-body temperatures of giant prehistoric reptiles, according to this hypothesis, must have been fairly constant and independent of environmental temperature—making dinosaurs, for all practical purposes, “warm-blooded.”

According to Southern folklore, a person bitten by a snapping turtle must wait until sundown for the turtle to give up its hold. While undoubtedly a myth, this story may have some basis in fact. Studies of behavioral temperature regulation have shown that when turtles cool down they are less able to perform any energetically costly behavior, including biting. The snapper will let go at sunset because it can’t stay warm enough to hang on any longer. □

Pond turtles bask amid waterlily pads in front of the Zoo's Reptile House. (Photo by Ami Warren)





Zoo portrait: Morning sunlight silhouettes an Eld's deer. (Photo by Milton Tierney)



Since this kitten was born through embryo transfer, NZP scientists have produced two litters of kittens through the more complex technique of in vitro fertilization.

RESEARCH UPDATE

• Two litters of kittens were born this April as a result of *in vitro* fertilization of domestic cats by NZP scientists. Although the procedure has proven successful in humans, the kittens are the first carnivores ever born through this sophisticated reproductive technique.

Last year, the same NZP team also produced a litter of kittens through embryo transfer, a process in which a naturally fertilized egg is removed from one female and implanted into another. In *in vitro* fertilization, egg and sperm are mixed in a test tube and the fertilized embryo is implanted into a female for gestation. In both procedures, the recipient female may be of the same or a taxonomically similar species; embryos may also be frozen and stored indefinitely until a suitable surrogate mother becomes available.

The culmination of two years of research by FONZ trainee Karen Goodrowe under the supervision of NZP Reproductive Physiologist David Wildt, this pioneering work with domestic cats has important implications in the captive breeding of selected endangered species of exotic cats.

• Georg Schwede, a doctoral student researching free-ranging white-tailed deer at the Zoo's Conservation and Research Center, has conducted a study of the breeding seasons of

Venezuelan and Virginia whitetails. Whereas North American whitetails produce young and breed only within distinct four-week periods, Schwede found that their Venezuelan counterparts breed over a much longer time without a marked "season." Schwede attributes the Venezuelan deer's relaxed breeding season to the greater abundance of food which results from less distinct tropical seasons.

HELP A FONZ INTERN

FONZ summer interns will need housing near the Zoo or near public transportation from late May to early September. If you have a room in your house that will be empty this summer or if you need a housesitter, why not help a future Marlin Perkins or Jane Goodall?

These interns are a very select group of dedicated college students—some of the brightest and best of future zoo professionals. To help them, please call Mary Sawyer Hollander, 673-4955.

NZP HISTORY

In 1902, after years of effort, an Alaskan expedition returned triumphant with the National Zoo's first Kodiak bear. Or so they believed. What they thought they saw was not exactly what they got—in more ways than one.

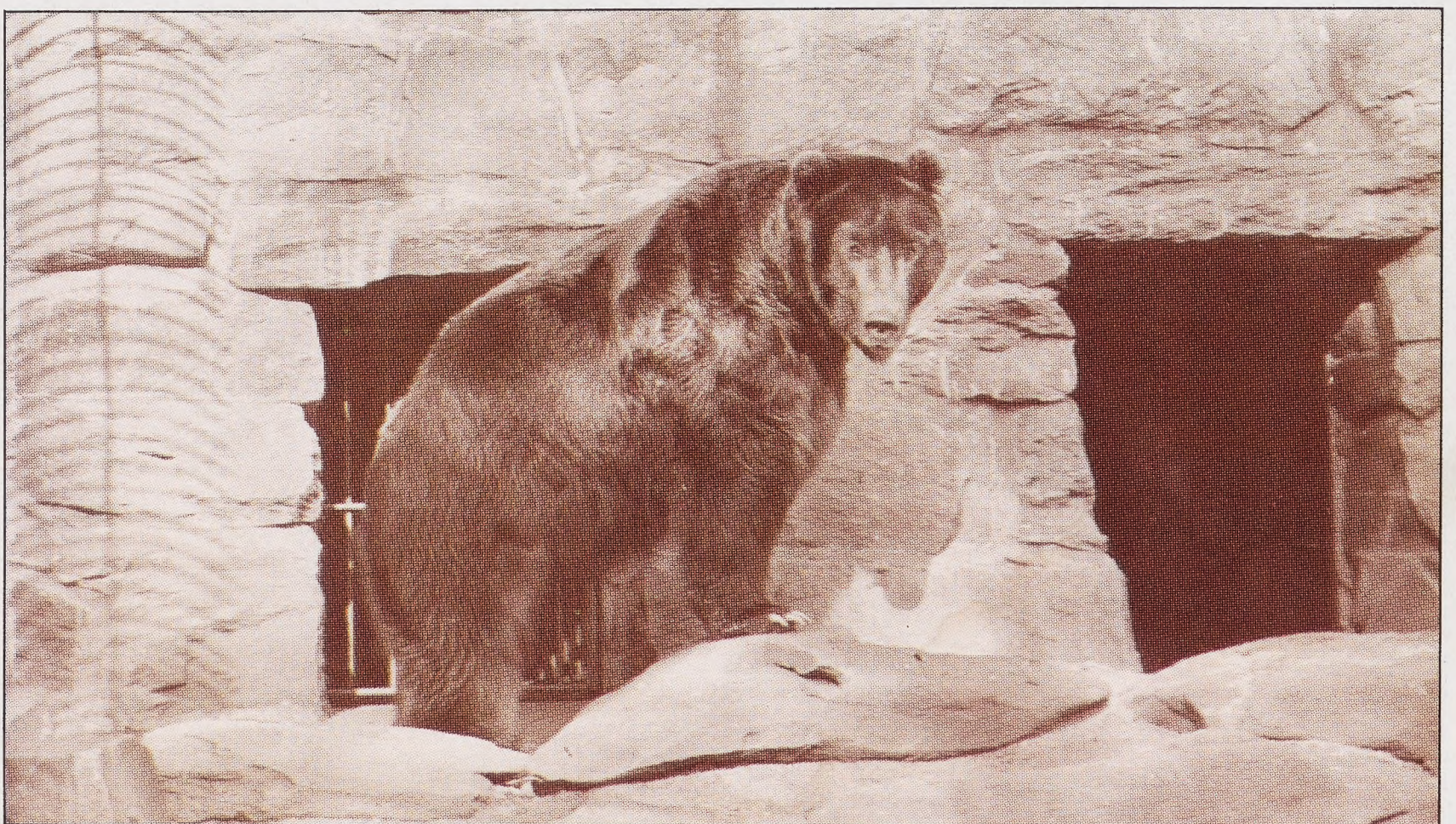
Zoo officials soon discovered that their prize—a male cub, six weeks old and 18 pounds at the time of cap-

ture—was not a Kodiak bear as they had expected, but an Alaskan Peninsula brown bear. He was also quite a handful. Over the course of the long journey to the Zoo, the cub's weight had increased tenfold, to 180 pounds. In the next year, the cub's weight more than doubled—and when his new enclosure was completed on June 15, 1903, Buster moved in, tipping the scales at 450 pounds.

The bear's enormous size and adventurous spirit earned him his name. At age 10, Buster weighed 1,160 pounds and measured 51 inches at the shoulder. His standing height was not recorded, but reportedly he could reach an apple on the end of a pole nine feet, three inches high when standing on his hind feet.

According to the Zoo's first head keeper William Blackburne, Buster was very playful, with a pleasant disposition. But his sociability was his downfall. At one point, Buster tried to woo the female polar bear in the next enclosure through a small opening in the partition between them. The polar bear gave him a "love bite" which resulted in the loss of a portion of his tongue. Unfortunately, the experience did nothing to dampen Buster's interest in his ursine neighbors. In 1914, he became so excited over a bear fight in an adjoining enclosure that he suffered a ruptured aorta and died instantly—a sad and unexpected end for the Zoo's unexpected "Buster."

—Billie Hamlet
NZP Historian



Sociable Buster



"Closer Look" class

SCHOOL AT THE ZOO

For 10 years, NZP educators have worked with local public school staffs in a popular six-week program that features close encounters with animals and hands-on experience with skins, bones, and other artifacts.

Each week, a Zoo bus transports students to and from NZP, where specially-trained FONZ guides lead classroom activities such as building a tropical forest habitat for a lizard or examining bird flight feathers under a hand magnifier. Afterwards, equipped like scientists with clipboards and checksheets, students observe and collect information about animals in the Park.

Called "Zoo Animals: A Closer Look," the program is open to D.C. 4th-grades and Arlington 6th-grades. For more information, call 673-4837.

CALL FOR NOMINATIONS

In accord with Article II of our bylaws, the FONZ Board of Directors is hereby soliciting nominations from the membership.

Board Responsibilities

As members of a "working" Board, FONZ Directors "administer and manage" the affairs of the Friends of the National Zoo. The Board of Directors establishes the policies of the corporation, approves budgets and expenditures, and otherwise directs the activities of FONZ officers and employees. Much of the Board's work is accomplished through active committees, including:

The *Administration Committee* establishes and supervises administrative policies and procedures for FONZ employees.

The *Education Committee* participates in development of FONZ-supported educational programs and supervises educational activities and NZP research grants authorized by the Board.

The *Finance Committee* institutes, develops and supervises fiscal operations.

The *Front Royal Committee* coordinates FONZ support programs at the Zoo's Conservation and Research Center at Front Royal, Virginia.

The *Membership Committee* is responsible for recruiting new members to FONZ and for developing membership activities.

The *ZooFari Committee* carries out fundraising for the Theodore H. Reed Animal Acquisition Fund and conducts an annual ZooFari benefit gala.

The *Visitor Services Committee* oversees management and operation of FONZ gift shops, food, parking, and other visitor service facilities at the Zoo.

All Board members serve on at least one committee, and attend two or more FONZ meetings each month. They serve on a voluntary basis without pay.

The criteria by which potential candidates are judged for nomination to the Board of Directors are: the candidate's strong interest in supporting zoological education, research and conservation in accordance with the purposes of our corporation; leadership; experience or skills that are needed and would directly benefit the management and operations of FONZ (particularly in the areas of development and marketing); and willingness and time to participate fully in FONZ work and activities. Candidates must be dues-paying members of FONZ.

Nomination Procedures

Nominations may be made only by dues-paying family, couple, or individual members in good standing. (Senior citizen, contributing, and patron membership of FONZ and members who previously joined the corporation as life members are entitled to all rights and privileges of dues-paying family, couple, or individual members.) Employees of FONZ or the National Zoo are not eligible for membership on the FONZ Board of Directors.

Nominations must be submitted on an official FONZ nomination form with a biographical sketch of the nominee attached. Nomination forms can be obtained at the FONZ office or will be mailed on request. For information or forms, call 673-4950. Deadline for submitting nomination forms can be obtained at the FONZ office or will be mailed on request. For information or forms, call 673-4950. Deadline for submitting nomination forms and accompanying biographical sketches is June 21, 1987. Address submissions to: William Bryant, Chairperson, FONZ Nominating Committee, National Zoological Park, Washington, D.C. 20008.

LETTERS

Dear ZooGoer,

Our class is happy to hear that the monarch butterfly will become a "star attraction" at the National Zoo this spring (Jan.-Feb. ZooGoer). In the fall, we observed the life cycle of the monarch. We talked, wrote in our journals, and drew pictures. After the monarchs emerged from their chrysalises, we dipped a cotton wick in a sugar solution and placed it under a paper flower. The brightness of the paper attracted the monarchs and they fed from the wick before we let them go.

Our teacher says we are all experts on the monarch butterfly.

Sincerely,

Mrs. Carol Hill's First Grade Class
Darnestown Elementary School
Gaithersburg, Md.



Monarch experts



Limited Edition ZooFari '87 Artwork Celebrating Canada

"Canada Geese," by noted wildlife artist Warren Cutler, is available in a special ZooFari limited edition, signed and numbered, 25½" × 32", \$135 including tax and handling.

Warren Cutler is an internationally recognized scientific illustrator of rare and endangered species, and has been working with zoologists and ornithologists for over 13 years. The Jersey Wildlife Preservation Trust in Great Britain and the Brazilian government have used his work to publicize their efforts for the preservation of endangered wildlife. In addition, his work is a part of the Smithsonian Institution's permanent collection in Washington, D.C.

To order "Canada Geese," fill out the coupon below or phone credit card orders to 332-WILD.

To: FONZ ZooFari '87, c/o National Zoo, Washington, D.C. 20008

☐ Yes! Send me a full-color print of "Canada Geese," signed and numbered by the artist.

_____ My check is enclosed (\$135, to FONZ).

Charge my VISA _____ or Master Card _____, number _____ exp. date _____

Name _____

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(delivery 4-6 weeks)

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National Zoological Park
Washington, D.C. 20008**

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